DEPARTMENT OF SYSTEMS ENGINEERING

Engineering Building, Suite 202
(970) 491-7067
engr.colostate.edu/se/ (https://www.engr.colostate.edu/se/)

Thomas Bradley, Department Head
Ingrid Bridge, Advisor and Graduate Program Manager

Graduate
Graduate Programs in Systems Engineering

Students interested in graduate work should refer to the Graduate and Professional Bulletin (http://catalog.colostate.edu/general-catalog/graduate-bulletin/) or visit the department website (https://www.engr.colostate.edu/se/).

The Master of Engineering program produces graduates who can design and manage complex multidisciplinary engineering systems with a rigorous systems engineering approach. The applied focus in courses builds skills that can be utilized immediately in current projects and prepares students for future career opportunities.

Graduates of the Master of Science program will be capable of designing and managing complex multidisciplinary engineering systems with a rigorous systems engineering approach. The research component of the thesis- and project-based M.S. programs equips students with cutting edge skills in specific focus areas, preparing them for future career opportunities.

The Ph.D. prepares students to become leaders in systems engineering. Throughout the program, students produce significant academic contributions in terms of original research to the field, driving advancements and leading to improvements in energy efficiency, environmental impact, cybersecurity, and economic growth, among other areas of application for systems engineering.

The Doctor of Engineering in Systems Engineering degree will include core studies in systems engineering and its applications to complex systems in a working environment. The curriculum includes professional and applied/translational courses, a systems engineering practicum, and a dissertation to assist working professionals in attaining a higher level of value for their organizations.

Certificate

- Graduate Certificate in Systems Engineering Practice (http://catalog.colostate.edu/general-catalog/colleges/engineering/systems-engineering/graduate-certificate-systems-engineering-practice/)

Master's Programs

- Master of Science in Systems Engineering, Plan A
- Master of Science in Systems Engineering, Plan B (http://catalog.colostate.edu/general-catalog/colleges/engineering/systems-engineering/systems-engineering-ms/)

- Master of Engineering, Plan C, Systems Engineering Specialization (http://catalog.colostate.edu/general-catalog/colleges/engineering/plan-c-me-systems-engineering-specialization/)

Ph.D.

- Ph.D. in Systems Engineering (http://catalog.colostate.edu/general-catalog/colleges/engineering/systems-engineering/systems-engineering-phd/)

Professional Doctorate

- Doctor of Engineering in Systems Engineering (http://catalog.colostate.edu/general-catalog/colleges/engineering/systems-engineering/systems-engineering-professional-doctorate/)

Courses

SYSE 501 Foundations of Systems Engineering Credits: 3 (3-0-0)
Course Description: Functional components of systems engineering, application of systems engineering to practical problems, system life-cycle process.
Prerequisite: None.
Registration Information: Sections may be offered: Online. Credit allowed for only one of the following: ECE 501, ENGR 501, or SYSE 501.
Terms Offered: Fall, Spring.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 505 Systems Thinking for the Real World Credits: 3 (3-0-0)
Course Description: Application of systems thinking language, tools, and framework for solving real-world complex issues.
Prerequisite: None.
Restriction: Must be a: Graduate.
Registration Information: Graduate standing. Sections may be offered: Face-to-Face, Mixed Face-to-Face, or Online. Credit not allowed for both SYSE 505 and SYSE 580A2.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 512 Systems Sensing and Imaging Analysis Credits: 3 (3-0-0)
Course Description: Sensing, sampling, filtering, transducing, and transmission of information to transform physical data to the digital domain. Subsequent processing of image and digital data, restoration, analysis and classification to problems in inspection, authentication, color science, biometrics, and signal/image characterization.
Prerequisite: ECE 303 or STAT 303 or STAT 315.
Registration Information: Sections may be offered: Face-to-Face, Mixed Face-to-Face, or Online. Credit not allowed for both SYSE 512 and ENGR 681A2.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 530 Overview of Systems Engineering Processes Credits: 3 (3-0-0)
Course Description: Systems engineering life-cycle process and analysis techniques. Reliability and robustness.
Prerequisite: ECE 303 or STAT 303 or STAT 315.
Registration Information: Sections may be offered: Online. Credit allowed for only one of the following: ECE 530, ENGR 530, or SYSE 530.
Terms Offered: Fall, Spring.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 532 Dynamics of Complex Engineering Systems Credits: 3 (3-0-0)
Also Offered As: ECE 532.
Course Description: Higher-level behavior and issues that emerge from interaction between components in complex socio-technical systems.
Prerequisite: ECE 501, may be taken concurrently or ENGR 501, may be taken concurrently or SYSE 501, may be taken concurrently.
Registration Information: Sections may be offered: Online. Credit allowed for only one of the following: ECE 532, ENGR 532, or SYSE 532.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 534 Human Systems Integration Credits: 3 (3-0-0)
Course Description: Evaluation of human capabilities and limitations when designing and evaluating complex systems in order to enhance safety, efficiency, usability, and reduce life cycle costs.
Prerequisite: None.
Restriction: Must be a: Graduate.
Registration Information: Bachelor's degree required. Sections may be offered: Face-to-Face, Online, or Mixed Face-to-Face. Credit not allowed for both ENGR 581A4 and SYSE 534.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 536 Space Mission Analysis and Design Credits: 3 (3-0-0)
Course Description: A mission and systems perspective on the many involved aspects of engineering a system with a space element. Evaluation of multiple combinations of architectural elements and operational procedures to meet a broad set of stakeholder needs, including hidden and non-technical needs.
Prerequisite: SYSE 501.
Restriction: Must be a: Graduate.
Registration Information: Sections may be offered: Online. Credit not allowed for both SYSE 536 and SYSE 580A4.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 541 Engineering Data Design and Visualization Credits: 3 (3-0-0)
Course Description: Data design, aggregation and filtering, intuitive data exploration, effective communication of patterns, summaries, and findings, and methods of archiving for engineers.
Prerequisite: ECE 303 or STAT 303 or STAT 315.
Registration Information: Sections may be offered: Face-to-Face, Mixed Face-to-Face, or Online. Credit not allowed for both ENGR 580A5 and SYSE 541.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 544 Systems-Based AR/VR Environmental Realism Credits: 3 (3-0-0)
Course Description: Systems approaches to create environmental realism in augmented reality/virtual reality (AR/VR) applications, with examples in manufacturing, agriculture, space flight, and healthcare. Topics include test, measurement, and qualification of the environments of interest, functional/quantifiable verification of replication, and systems engineering practice-inspired means of designing/specifying the content of the AR/VR applications.
Prerequisite: ECE 303 or MECH 231 or STAT 303 or STAT 315.
Registration Information: Sections may be offered: Face-to-Face, Mixed Face-to-Face, or Online. Credit not allowed for both SYSE 544 and SYSE 581A1.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 545 Augmented/Virtual Reality Systems Development Credits: 3 (3-0-0)
Course Description: A systems-based approach to utilizing Social Virtual and Augmented Reality as platforms for designing and implementing AR/VR learning experiences.
Prerequisite: ECE 303 or MECH 231 or STAT 303 or STAT 315.
Restriction: Must be a: Graduate.
Registration Information: Sections may be offered: Online. Credit not allowed for both SYSE 545 and SYSE 580A5.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 548 Security Engineering for Systems Engineers Credits: 3 (3-0-0)
Course Description: Secure design concepts, leveraging modern case studies of offensive approaches used by attackers. Topics include threat analysis, usability, protocols, cryptography, access control, economics, multilevel security, locks, monitoring, security printing, nuclear command, biometrics, side channels, networks, and information warfare.
Prerequisite: None.
Restriction: Must be a: Graduate.
Registration Information: Sections may be offered: Online.
Term Offered: Spring (even years).
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 549 Secure Vehicle and Industrial Networking Credits: 3 (3-0-0)
Course Description: Theoretical and practical applications of secure communications in automotive and industrial networked systems. Industry standards used to understand challenges of balancing requirements for cybersecurity and functional performance. Networks include IP networks, Ethernet, in-vehicle networks, Controller Area Networks, SAE J1939 and diagnostic systems. Coverage includes physical connections, encoding, message framing, media access control, error detection, cryptography and application security.
Prerequisite: CS 163 or CS 164.
Registration Information: Sections may be offered: Face-to-Face, Mixed Face-to-Face, or Online. Credit not allowed for both ENGR 580A6 and SYSE 549.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 555 Transitions in Energy Systems Credits: 3 (3-0-0)
Course Description: Study and investigation of the technical, operational, environmental, economic, social, and political transitions that are underway in the energy sector, and in particular those that impact the design, development, and deployment of energy systems of the future.
Prerequisite: STAT 301.
Restriction: Must be a: Graduate.
Registration Information: Sections may be offered: Online. Credit not allowed for both SYSE 555 and SYSE 581A2.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 567 Systems Engineering Architecture Credits: 3 (3-0-0)
Course Description: Observation/classification of systems architecture. Systems architecture principles and critical evaluation through design studies.
Prerequisite: ECE 501 or ENGR 501 or SYSE 501.
Registration Information: Sections may be offered: Online. Credit allowed for only one of the following: ECE 567, ENGR 567, or SYSE 567.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 569 Cybersecurity Awareness for Systems Engineers Credits: 3 (3-0-0)
Course Description: Cybersecurity principles, practices, technologies, design approaches, and terminology needed to incorporate cybersecurity principles into effective systems designs.
Prerequisite: ENGR 501 or SYSE 501.
Registration Information: Bachelor's degree required. Sections may be offered: Online. Credit allowed for only one of the following: ENGR 569, ENGR 580A4, or SYSE 569.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 571 Analytics in Systems Engineering Credits: 3 (3-0-0)
Course Description: Focus on the appropriate application of data mining, knowledge generation, data analytics and data algorithmics to large complex systems. Demystify "big data" for systems engineers as applied to intelligent systems.
Prerequisite: None.
Restriction: Must be a: Graduate.
Registration Information: Bachelor's degree required. Sections may be offered: Face-to-Face, Mixed Face-to-Face, or Online. Credit not allowed for both ENGR 571 and SYSE 571.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 573 Cost Optimization for Systems Engineers Credits: 3 (3-0-0)
Course Description: Techniques and strategies to respond to requirements, design, development and manufacturing decisions, while optimizing for cost at the organizational, program, and project level.
Prerequisite: ENGR 502 and ENGR 531.
Restriction: Must be a: Graduate.
Registration Information: Sections may be offered: Face-to-Face, Online, or Mixed Face-to-Face. Credit not allowed for both ENGR 581A3 and SYSE 573.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 596 Group Study-Systems Engineering Skills Credits: Var[1-2] (0-0-0)
Course Description: Topics related to building specialized skills relevant for the systems engineering field.
Prerequisite: None.
Registration Information: Bachelor's degree required. Sections may be offered: Online.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 597 Group Study in Systems Engineering Credits: 3 (0-0-3)
Course Description: Special and contemporary topics in the field of systems engineering.
Prerequisite: None.
Restriction: Must be a: Graduate.
Registration Information: Graduate standing. Sections may be offered: Online.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 602 Systems Requirements Engineering Credits: 3 (3-0-0)
Course Description: Introduction to the rigorous requirements process within systems engineering, including system requirements analysis, requirements decomposition, allocation, tracking, verification, and validation.
Prerequisite: (ENGR 501 or SYSE 501) and (ENGR 530 or SYSE 530).
Restriction: Must be a: Graduate, Professional.
Registration Information: Sections may be offered: Online. Credit allowed for only one of the following: ENGR 602, ENGR 680A2, or SYSE 602.
Term Offered: Fall.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 603 Introduction to Systems Test and Evaluation Credits: 3 (3-0-0)
Course Description: Test and evaluation of systems at both the component and systems levels to provide insights into how systems succeed or fail based on test methodologies.
Prerequisite: ENGR 502 and ENGR 531.
Restriction: Must be a: Graduate, Professional.
Registration Information: Bachelor's degree required. Sections may be offered: Face-to-Face, Mixed Face-to-Face, or Online. Credit allowed for only one of the following: ENGR 603, ENGR 680A3, or SYSE 603.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 667 Advanced Model-Based Systems Engineering Credits: 3 (3-0-0)
Course Description: Theory and application of formal systems architecture modeling.
Prerequisite: ENGR 567 or SYSE 567.
Restriction: Must be a: Graduate, Professional.
Registration Information: Sections may be offered: Online. Credit not allowed for both ENGR 567 or SYSE 567.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 695 Independent Study Credits: Var[1-18] (0-0-0)
Course Description:
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Registration Information: Sections may be offered: Online.
Terms Offered: Fall, Spring, Summer.
Grade Mode: S/U Sat/Unsat Only.
Special Course Fee: No.

SYSE 699 Thesis Credits: Var[1-18] (0-0-0)
Course Description:
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Registration Information: Sections may be offered: Online.
Terms Offered: Fall, Spring, Summer.
Grade Mode: S/U Sat/Unsat Only.
Special Course Fee: No.

SYSE 701 Research Methods in Systems Engineering Credits: 3 (3-0-0)
Course Description: Introduction to the systems engineering research field and program expectations.
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Registration Information: Sections may be offered: Face-to-Face, Mixed Face-to-Face, or Online. Credit not allowed for both SYSE 701 and SYSE 780A1.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 710 Leadership/Innovation in Systems Engineering Credits: 3 (3-0-0)
Course Description: Background in technical leadership skill sets, systems engineering skillsets, and intellectual toolkit to develop a successful applied and translational research project/practicum.
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Registration Information: Bachelor's degree required. Sections may be offered: Online. Course is not available for credit toward the PhD in Systems Engineering. Credit not allowed for both ENGR 710 and SYSE 710.
Terms Offered: Fall, Spring.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 711 Ethics in Systems Engineering Credit: 1 (0-0-1)
Course Description: Ethical principles and their application to systems engineering.
Prerequisite: ENGR 501 or SYSE 501.
Restriction: Must be a: Graduate, Professional.
Registration Information: Offered as an online course only. Credit not allowed for both ENGR 711 and SYSE 711.
Terms Offered: Fall, Spring.
Grade Mode: Traditional.
Special Course Fee: No.

SYSE 786 Applied Systems Engineering Practicum Credits: Var[1-9] (0-0-0)
Course Description: Research techniques, critical thinking, evaluation criteria, and methods of technical writing.
Prerequisite: ENGR 710 or SYSE 710.
Restriction: Must be a: Graduate, Professional.
Registration Information: Written consent of advisor.
Terms Offered: Fall, Spring, Summer.
Grade Mode: S/U Sat/Unsat Only.
Special Course Fee: No.

SYSE 795 Independent Study Credits: Var[1-18] (0-0-0)
Course Description:
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Registration Information: Sections may be offered: Online.
Terms Offered: Fall, Spring, Summer.
Grade Mode: S/U Sat/Unsat Only.
Special Course Fee: No.

SYSE 799A Dissertation: PhD Credits: Var[1-18] (0-0-0)
Course Description: Dissertation for PhD in System Engineering Program.
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
Registration Information: Written consent of advisor. Sections may be offered: Online.
Terms Offered: Fall, Spring, Summer.
Grade Mode: S/U Sat/Unsat Only.
Special Course Fee: No.

SYSE 799B Dissertation: Professional Doctorate Credits: Var[1-9] (0-0-0)
Course Description:
Prerequisite: SYSE 786.
Restriction: Must be a: Graduate, Professional.
Registration Information: Written consent of advisor. Admission to Professional Doctorate of Engineering, Systems Engineering.
Terms Offered: Fall, Spring, Summer.
Grade Mode: S/U Sat/Unsat Only.
Special Course Fee: No.